



Common Adult Fractures

Objectives:

- ◆ Clavicle fracture
- ◆ Humerus (proximal & shaft)
- ◆ Both 'bone' forearm 'fracture'
- ◆ Distal 'radius' fracture
- ◆ Hip fracture
- ◆ Femur 'shaft' fracture'
- ◆ Tibial 'shaft' fracture'
- ◆ Ankle' fracture

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References: 435 Team, Toronto note, Slides, Notes

★ Upper Extremities

1. Clavicle Fracture [Toronto notes](#)

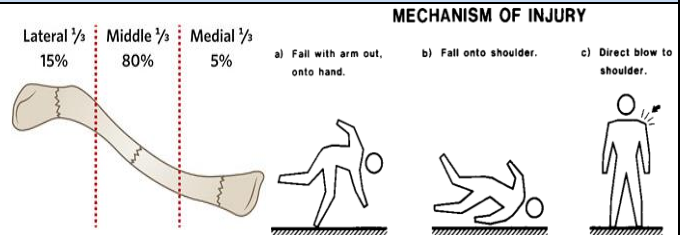
★ Anatomy

- Clavicle is **S** shape bone.
- It is anchored to scapula via ACJ (Acromioclavicular joint).
- It is anchored to trunk via SCJ (Sternoclavicular Joint)



★ General Notes

- Most of fracture occurs as result from **fall onto shoulder**. FOOSH (Fall on An Outer Stretched Hand)
- Fracture is classified into: proximal, middle and lateral third fractures.
- Most of fractures are of **middle third**.



★ Clinical Findings

- Injury to brachial plexus and subclavian artery/vein may be present.
- Rarely, Pneumothorax can occur.

★ Imaging

X-Ray:

1. AP chest.
2. Clavicle special view (focused on clavicle) (30° cephalic tilt), This X-Ray shows Middle third clavicle fracture with minimal displacement.

(This X-ray shows a short oblique middle third fracture).



★ Treatment

Will you reduce clavicle fracture? **No**, we use the gravity to reduce it. We use a sling as a type of immobilization.

- **Most of clavicle fractures** are treated with a sling (non-operative management).



- Few fractures should be treated **surgically** with **open reduction¹** and **internal fixation** with screws and plates:

1. **Skin is tented** (See pic), why? because of concern for an impending open fracture
2. **Severe displacement**: 100% displacement + 2 cm overlap. What is the other name for overlap? Shortening
يعني العظمة تدخل فوق بعض أو على بعض فيقصر طولها.



¹ What is the difference between open and closed reduction?

→ **Closed reduction**: you can open the skin and everything but **away from the fracture**, and you do the surgery, but you do not expose the fracture site (away from it).

→ **Open reduction**: if the **fractured bone is exposed** and you can see the bone fragments by your eyes and **manipulated by your hands** and you reduce the fragments.

2. Proximal Humerus Fracture

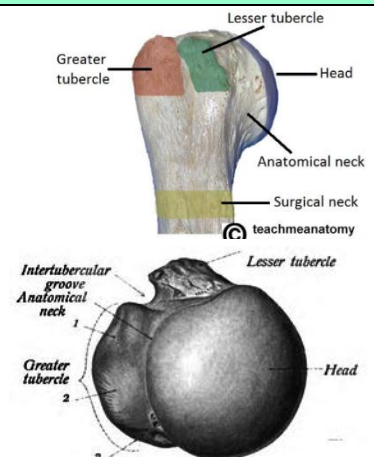
★ Anatomy

Has **four** anatomic parts:

1. Head.
2. Greater tuberosity **GT** (Muscles attached: Supraspinatus “abduction” + infraspinatus “external rotation, lateral abduction” + pectoris minor “Internal rotation”)
3. Lesser tuberosity **LT** (Muscle attached: Subscapularis “internal rotation”)

Didisector groove runs between GT & LT (See extra 2 pics) ->

4. Shaft.
5. Anatomical neck vs. Surgical neck anatomical neck is between the tuberosities and the head while surgical neck is between the tuberosities and the shaft. Why is it called surgical neck? Because this is the location of many fractures that require surgery.



★ General Notes

- Younger patients: **violent** trauma such as RTA.
- Older patients: **minor** trauma.
- **Most fractures are minimally displaced.**

Physical exam:

1. Expose the shoulder very well.
2. **Look for fracture signs** (swelling, tenderness, inability to move, ecchymosis).
3. Check the skin. To know if it is an open or closed fracture (**unlikely to have an open fracture of proximal humerus** bc it's deep). Examine the **axilla**, most of times they forget to examine it because pt has a lot of pain or they simply forget.
4. Peripheral N/V exam.
5. **Axillary nerve:** lateral skin patch (See pic) sensory over the deltoid, in case of motor deficit: inability to **abduct** the arm.
6. Examine cervical spine (the area is supplied by axillary nerve), you have to **examine joint above** (cervical spine) **and joint below** (the elbow)



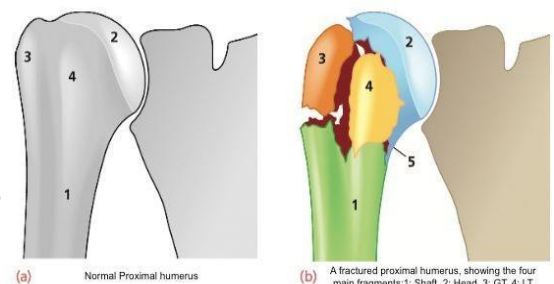
★ Imaging [Watch](#) helpful!

- Fracture is defined by the fragments displaced (Neer's classification)
- Displacement: more than 1 cm and/or angulation $>45^\circ$

يعني عشان اعتبر هذي الفراقمت بارت لازم تكون مزاحة أكثر من 1 سم أو معطوبة بزواية 45

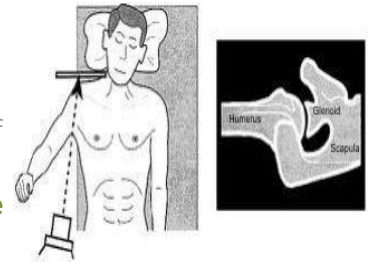
Classification:

- Imagine that you cracked the anatomical neck, the surgical neck and you have a crack between the GT and LT → **you will end by having 4 pieces**. If you have 1
- 1 Fracture line → you will get 2 pieces. 2 fracture lines → 3 pieces. 3 fracture lines → 4 pieces
- If we have all the fractures but not displaced, we call this non-displaced humerus fracture (one-part fracture). If not displaced, we **don't** count the fragments.
- If there is a fracture with displacement **more than 1 cm** between the fragments, then we count the fragments. If there is 2 fragments, we call it 2 fragments fracture “two-part fracture” and so on.
- **If all the major parts are displaced** (the head of the humerus, the lesser tuberosity, the greater tuberosity and the shaft), **it is a four-part fracture**.

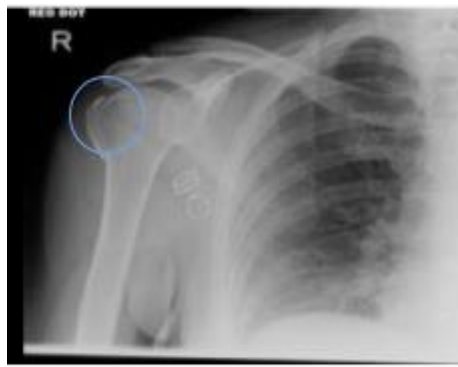


X-Ray: to make sure proximal humerus is not displaced

- AP and lateral views: you need 2 perpendicular (Orthogonal) views, why? To have 3D image of the fracture.
- Axillary view (special X-ray): the patient is laying down, and the beam will go through the axilla to allow you see this view (the whole joint), it can show you if there is a **fracture dislocation** (it has different management) **if there is a fracture and obvious displacement we usually do CT to categories the fracture and see how many fragment.** If fracture extends into the joint → CT.



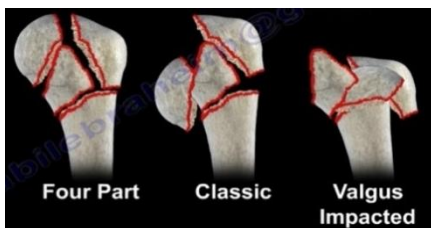
Normal



Minimally displaced fracture of the greater tuberosity. **Anatomic neck fracture impeded into valgus** bec this is not the normal angle.



4 parts fracture but it's hard to tell due to overlap.



See extra pic

★ Treatment

If fracture is not displaced:

- Treatment with sling immobilization and NWB (non-weight bearing) of upper extremity for 6-8 weeks. Why? based on the healing process of the fracture.
- Early ROM exercises **pedaling exercise** (pend the back and move the arm in circular motion) after 2-4 weeks.
- Normal function can be resumed after 3-4 months.

If the fracture is displaced: intra-articular

- **Surgery** is indicated.
- **ORIF** is indicated (plate and screws).
- **Shoulder hemi-arthroplasty** is indicated in some cases.



3. Humerus Shaft Fracture: [Toronto notes](#)

★ General Notes

It can be classified **based on location of fracture.** (proximal, middle and distal)

★ Clinical Findings

Symptoms: pain, swelling, weakness ± shortening, motion/crepitus at fracture site

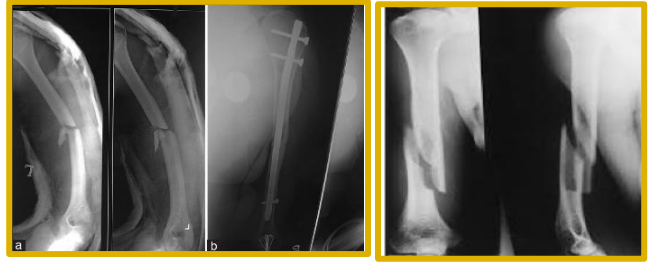
Physical exam:

- Skin.
- Compartment.
- N/V (neurovascular): watch for **radial nerve palsy**. How to examine the radial nerve? **Motor:** Extension of the wrist. **Sensory** over the dorsum of the first webspace.

★ Imaging

X-Ray:

The pic is showing a spiral fracture at the junction of mid and distal third ->

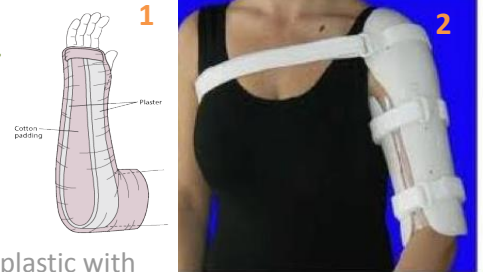


★ Treatment

Almost all humerus shaft fracture can be treated **non-surgically**.

Before the brace, we do sugar tong splint (u shaped) pic 1 and after 1-2 weeks we go for brace pic 2.

- Close reduction.
- **Functional brace** x 4-6 weeks + NWB.
- **Early ROM of elbow and shoulder** to avoid stiffness



What is the difference between brace and cast? the brace is removable, plastic with velcro tape, clamshell. There is no significant difference compared to the cast but it's easier to the patient.

Surgery is indicated (ORIF with plate and screws) for specific conditions like:

- **Segmental fracture**, big fragment in the middle.
- Open fracture.
- **Obese patient, why?** Because of body built which will push the humerus and displace it, and also, they have a lot of fat which push the arm into varus.
- **Bilateral fracture, why?** Patient can't function with 2 casts (inhumane).
- **Floating elbow** (Fracture of forearm and humerus) difficult to control.



4. Both Bones Forearm Fracture (Means radius and ulna are broken)

★ Anatomy

Forearm is complex with two mobile parallel bones; we consider the forearm as a ring or one joint (quadrilateral joint).

Radius and ulna articulate proximally and distally, by the proximal and distal radioulnar joint (DRUJ) to allow forearm rotation.

★ General Notes

Fractures are often from fall or direct blow.

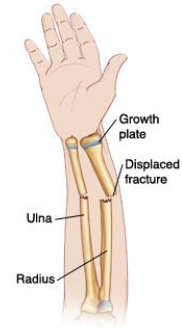
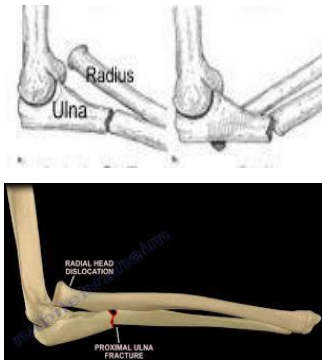
It very unlikely to fracture only one bone without disruption of their articulation.

Types:

1. **Both bone fracture:** Means radius and ulna are broken. **Right pic** "extra"
2. **Monteggia fracture²:** Means proximal or middle third ulna shaft fracture with dislocation of radius proximally (at elbow). Ulna is the fractured big bone, **radius is the dislocated one**. Mechanism: direct blow on the posterior aspect of the forearm, hyper-pronation or fall on the hyperextended elbow. Clinical Features: decreased rotation of forearm ± palpable lump at the radial head. **Left pics**
3. **Galeazzi fracture³:** Means distal or middle third shaft radius fracture with disruption of DRUJ. Radius is fractured, ulna is dislocated from DRUJ (Distal radioulnar joint) Mechanism: hand FOOSH (Fall on An Outer Stretched Hand) with axial loading of pronated forearm or direct wrist trauma. **Pic middle**

² [Toronto notes](#)

³ [Toronto notes](#)



★ Clinical Findings

- Symptoms and signs of fracture: deformity, pain, swelling loss of function in hand and forearm
- Check the skin.
- **Check the compartments of forearm.**
- **Check Ulnar, median and radial nerve (PIN, AIN).** "Posterior & anterior interosseous nerves"
- Check vascularity: color, temperature, capillary refill and pulse.

★ Imaging

- 2 orthogonal views perpendicular on each other with joint above and below.
- CT scan if fracture extends into joint (intra-articular fracture).



★ Treatment

1. **Both bone fracture:**

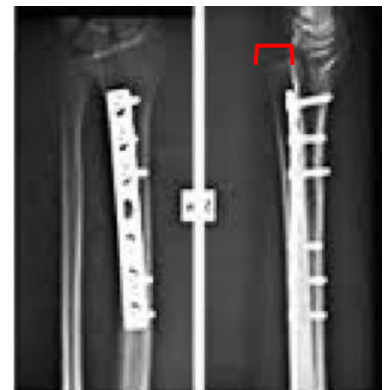
- Reduce and splint at ER/clinic (temporary)
- Are treated **almost always with ORIF**: (plate and screws) even if it didn't displace because we worry that it will later if we left it.

2. **Monteggia fracture:**

ORIF ulna and close reduction of radial head if closed failed go for open.

3. **Galeazzi fracture:**

ORIF radius and close reduction of DRUJ. This x-ray shows Galeazzi fixation because the radius is مصلحة



لو تلاحظوا الأحمر اللي رسمته على الصورة، هذي الدستل ألنا مب مرجعيتها مكانها فهذي العملية مب كويسة \

5. Distal Radius Fracture

★ General Notes

- Most common fracture of **upper extremity**.
- Most frequently are seen in **older women**. Young adults fractures are most commonly secondary to high energy trauma.

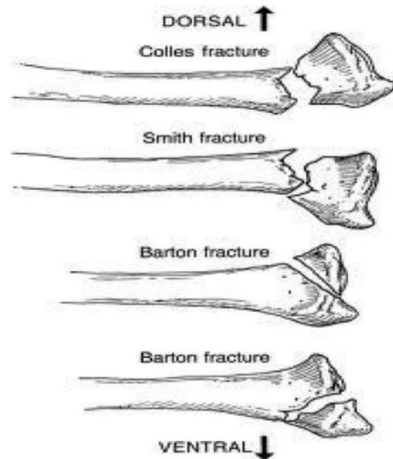


○ Types:

1. **Extra-articular:** A. Colles fracture⁴, B. Smith's fracture⁵

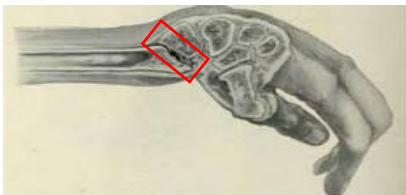
2. **Intra-articular:** A. Volar Barton's fracture, B. Dorsal Barton's fracture, C. Others. في الأبر اكستريميتيز

it's due to a fall on extended pronated wrist. \: انتيرير وبوستيرير



★ Types:

Extra-articular - Colles' Fracture: Dorsal angulation shortening and radial deviation. When we talk about colles' we need to mention these 3: Extra-articular + dorsal angulation + distal radius fracture. لاحظوا المربع الأحمر اللي رسمته على الصورة، الكسر ما وصل للأرتكولر سيرفيس



Extra-articular - Smith's fracture: Volar angulation (displacement) and shortening. (reverse Colles')



Intra-articular - Volar Barton's fracture it equals type 3 smith's fracture "involving distal radius inter-articularly"



Dislocation of radiocarpal joint

Intra-articular - Dorsal Barton's fracture



⁴ Toronto notes

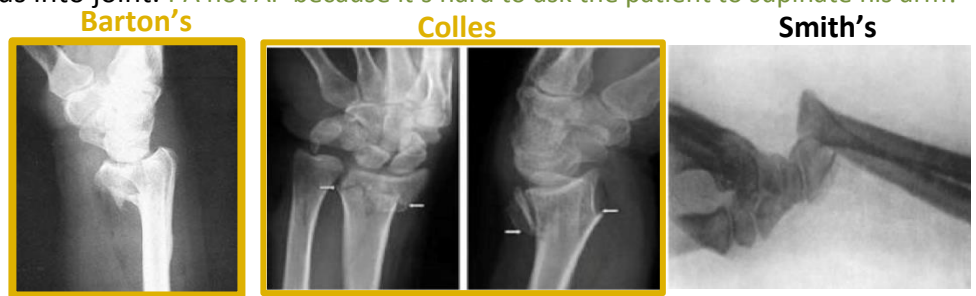
⁵ Toronto notes

★ Imaging

X-ray and do CT if fracture extends into joint. PA not AP because it's hard to ask the patient to supinate his arm!

In Barton's fracture you have to see it in lateral x-ray because AP there is overlap (no fracture is seen)

If extended into joint we ask for **CT**.



★ Treatment

Extra-articular fractures:

- Closed reduction and below elbow cast "to avoid elbow stiffness" application.

After fracture reduction we do **X-Ray** to decide the definitive treatment, if the fracture is in accepted position then continue in the cast, if the fracture is not in accepted position > do surgery for the patient. I will not tell you about the accepted position (too much information for you).

- Immobilization for 6-8 weeks.
- ROM exercises after cast removal.
- Surgery: if reduction is not accepted ORIF

Intra-articular fracture:

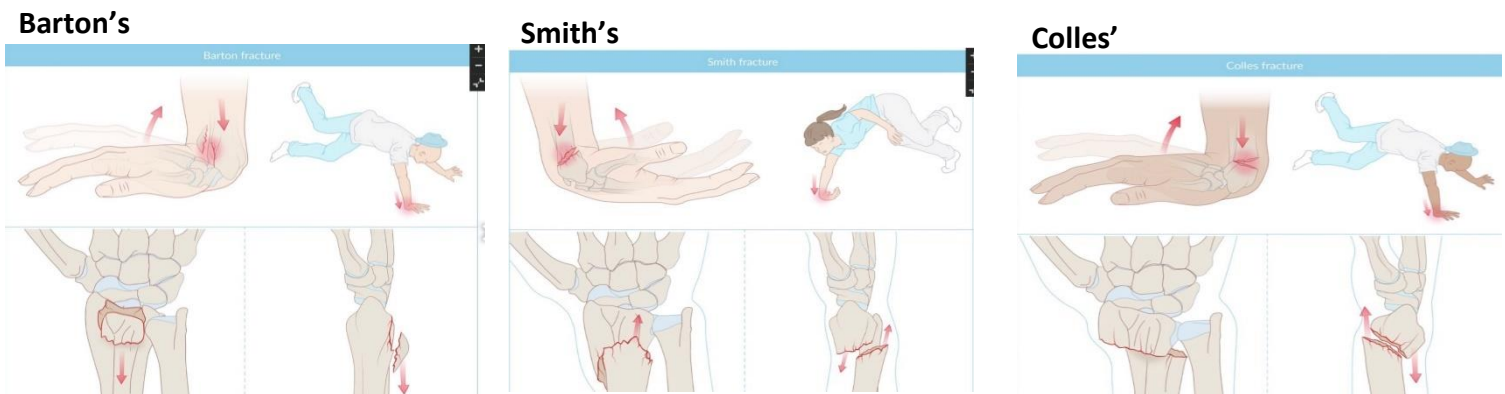
A step **more than 2 mm displacement** is an indication for surgery.

ORIF with plate and screws.



ORIF with the plate and screws

Extra pic to explain the idea even more:



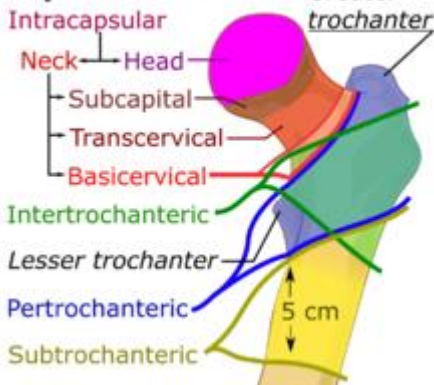
★ Lower Extremities

1. Hip fracture⁶ (Old patient: > 60 yrs the physiological age is what matters not the exact age, because you can have a 60 y/o male but he is completely fit and healthy with no issues but stick with what's written here.. 60 is old ;))

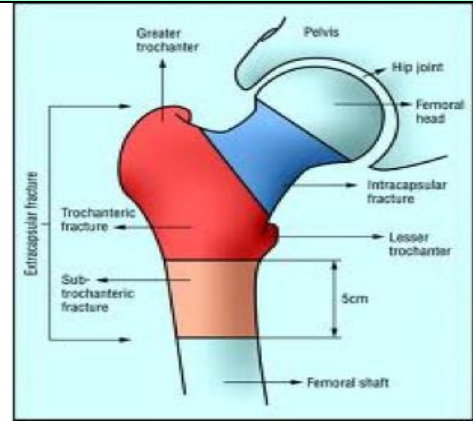
⁶ [Toronto notes](#)

★ Anatomy

Hip fractures



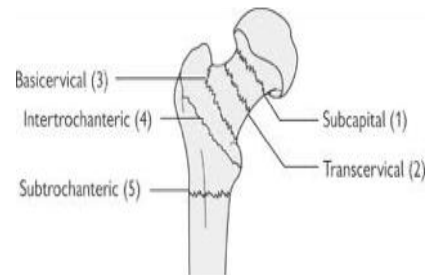
<- This pic at the left is extra but the doctor mentioned all the labeled areas within it so it's better to understand it.
Pic at the right is from -> doctor's slides.



★ General Notes

The usual story of this fracture: a geriatric patient falls down in the bathroom and it is usually managed by surgery.

- It is the most common fracture of LL.
- It is associated with osteoporosis.
- Most common mechanism is a fall from standing height.
- Other causes of fall (stroke, MI) should be rolled out during clinical evaluation; you should ask the patient about the cause of falling down, because this can be the only manifestation of MI or stroke.
- It is a life changing event it's not about the fracture itself, but it's about the systemic failure "The patient starts to be senile". Most people will walk but they will not be the same. Mortality: 20% of these people will die 1 year after the fracture. Not because of the fracture, it just tells you how it's linked to systemic failure.



Fractures can be classified into:

◆ Intra-capsular:

- Subcapital (below the head) (Femoral head and neck junction)
- Trans-cervical (mid portion of femoral neck)

◆ Extra-capsular:

- Basicervical (base of femoral neck)
- Intertrochanteric
- Subtrochanteric

- AVN risk is higher with intra-capsular fracture.
- Displaced vs non-displaced.

★ Clinical Findings

- Full detailed history of mechanism of injury.
- Rule out syncope, chest pain, weakness etc.
- A detailed systematic review.
- Deformity: Abduction, External rotation and shortening.
- Assess distal N/V status
- Avoid ROM if fracture is expected

#Common associated injuries:

- 1- Distal radius fracture.
- 2- Proximal humerus fracture.
- 3- Subdural hematoma.

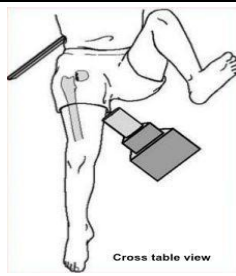
★ Imaging

X-Ray:

3 views are needed:

1. AP pelvis.
2. AP hip
3. Lateral hip "frog leg", how can we get lateral hip X-Ray? cross table lateral, the patient rises the normal

leg, and the image is taken from down
MRI is sensitive for military occult fractures.



★ Treatment

- **No** close reduction is needed, why? a study showed that there is **no difference** if you put a traction or not, not cost effective, and no benefit for the patient.
- **No traction is needed.**
- Patient needs **surgery** ideally within **48 hrs** even less, why? a study showed that **mortality** is higher after 48 h.
- The goal is to ambulate patient as soon as possible.
- Be sure that DVT prophylaxis is started. For all hip fracture
- **Be sure that patient will be evaluated for osteoporosis after discharge.**

◆ If fracture is intra-capsular:

Hemiarthroplasty: percutaneous in situ Screws fixation.

1. **Displaced:** Hemiarthroplasty "Old", I do not want to do ORIF because although theoretically it works in 65%, 35% will have AVN and they will need another surgery
2. **Non-displaced:** (if not displaced the **treatment is percutaneous in-situ screw fixation**)



Hemiarthroplasty



Percutaneous in-situ (in place without reduction) screw fixation.

◆ If fracture is Extra-capsular: the chance of AVN is minimum less than 5%

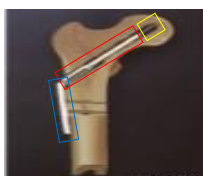
1. **Stable:** Close reduction and DHS. السيتيل المقصود الفراكتشر مو حالة المريض
2. **Unstable:** Cephalo-Intra-medullary device "Nail". **(Cephalomedullary nail)** with big screws that connect them to the femoral head. **MCQs!!!!!!!**

#Fracture instabilities signs:

- Large LT (lesser trochanter) fragment displaced on its own.
- Extension to subtrochanteric region.
- 4 parts fracture.

Remember that they are old patients and if you have one shot in your gun, you want it be accurate (you do want to take the patient multiple times to the OR)

if young patient always fix even if displaced (if you done hemiarthroplasty he will live for long time and will need to repeat for multiple time and eventually total hip replacement)



<- DHS (Dynamic hip screw)

Plate Barrel head screw



<- Percutaneous in-situ (in place without reduction) screw fixation.

★ Complications

1. Nonunion
 - 2% (IT inter-trochanteric fractures)
 - 5% (non-displaced neck fracture)
 - 30% (displaced neck fracture)
2. AVN (femoral neck fracture):
 - 10% (non-displaced)
 - 30% (displaced)
3. Death:
 - Early 4%.
 - At 1 year: 20-40%
4. VTE (Venous thromboembolism)

★ Examples

What is the type of this fracture?

Basicervical



What is the type of this fracture?

Subcapital transcervical (directly under the head)



What is the type of this fracture?

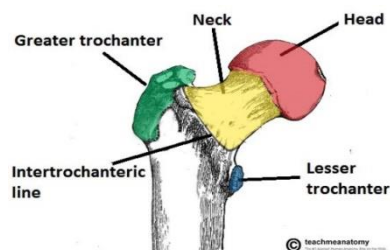
Intertrochanteric



2. Femoral Neck Fracture (Young patient)

★ Anatomy

Extra pic



★ General Notes

- It is a completely different entity from similar fractures in elderly (>60 years).
- High energy mechanism.
- ATLS protocol.

★ Complications

- **2.5% associated femoral shaft fracture. (that's why you need to get long femur X-ray)**
- Nonunion: 30% (most common complication).
- AVN: 25-30%

★ Treatment **IMPORTANT!!!!!!**

<u>Intracapsular fractures</u>		<u>Extracapsular fractures</u>	
Displaced	Nondisplaced	Staple	Unstapled
OLD? YOUNG? closed reduction open reduction and fixation with cannulated screws In young. the same as nondisplaced No hemiarthroplasty for young patients	closed reduction and percutaneous in situ Screw fixation (cannulated screws).	DHS	Cephalomedullary nail

3. Femoral Shaft Fracture⁷

★ General Notes

Most common:

1. High energy mechanisms (MVC, fall from a height, gunshot wound)
2. **Young patients (male, < 30 years).**
3. ATLS protocol.

Less common:

1. Low energy mechanism (torsional forces)
2. Old patients.
3. **Spiral type fracture.**

Associate musculoskeletal injuries:

1. Ipsilateral femoral neck fracture (10%. Missed in 30-50%). Missing a femoral neck fracture is associated with a high morbidity because you will treat the femoral shaft fracture with femoral nail and ask the patient to walk on it, if the neck was also fractured it will displace and the patient will come back to you complaining of pain, you will tell him it's fine, it's because the surgery and for a long time of neglectance the head will die and you now must do hip replacement surgery which is major. **So, in short, if you have a femoral shaft fracture always look for femoral neck fracture.**
2. Knee ligaments injuries: 50%
3. Meniscal tear 30%
4. Floating knee injury: less common **ipsilateral tibia and femur fractures at the same time.**
5. Vascular/nerve injuries: rare
6. Contralateral femur shaft fracture (worse prognosis among above).

Associated non-MS injuries:

1. Fat embolism.
2. ARDS.
3. Head injuries.
4. Abdominal injuries.

★ Clinical Findings

- ATLS.

- Fracture symptoms and signs.

- Skin integrity.
- Compartment assessment.
- N/V exam.
- Knee swelling or ecchymosis.

★ Imaging

- AP and lateral views femur. Joint above (spine, Bamboo spine) and joint below.
- 15° Internal rotation AP view (to get a good profile of the femoral neck) ipsilateral hip.
- Lateral view ipsilateral view
- If femoral neck fracture is suspected: CT scan hip.
- Knee AP and lateral views

★ Treatment

1. ATLS: ABC resuscitation.
2. Skeletal traction (proximal tibial pin) for pain control
3. **Early surgical fixation: is the key**
 - Proven to reduce Pulmonary complications. (PE or fat embolism).
 - Must be within 24 hrs (ideally < 6 hrs).
 - If patient is unstable: External fixation because of the time needed until he/she is stable, also nailing takes time and you want to intervene fast so you go for EF.
 - If patient is **stable** → Closed reduction & IM nailing.



★ Complications

1. Malunion:
 - a. Most common.
 - b. More common with proximal fracture (subtrochanteric fracture) because many muscles are acting on this site.
 - c. Rotational, angulation and shortening
2. **Nonunion**: rare
3. Infection.
4. VTE. Always give prophylaxis.

3. Tibia Shaft Fracture⁸

★ General Notes

- It is a subcutaneous bone (high suspicion for skin injury). Not a lot of muscles are covering it
- Most common large long bone fracture. And open bone fracture
- It can be secondary to low or high energy mechanism.
- **It carries the highest risk of compartment syndrome.** (cause it is small space and less distal muscles)
- 20% of tibial fracture can be associated with ankle intra-articular fracture.
- Classified based on:
 - A. Location and morphology:
 - Proximal third
 - Middle third
 - Distal third
 - B. Displaced vs. Non-displaced:

★ Clinical Findings

- Skin integrity.
- Assess compartments of leg: needs serial exam.

- Serial N/V exam.

★ Imaging

X-rays:

- AP and lateral tib/fib.
- AP/lateral knee
- AP/Lateral ankle

CT SCAN IF FRACTURE EXTENDS INTO JOINTS ABOVE OR BELOW.

المربعات الحمراء هي الكسر



<- pic left shows: comminuted tibial and fibular fractures + ankle fracture.

★ Treatment

Indications for non-surgical treatment:

1. NO displacement: < 10° angulation on AP/lateral x rays.
2. < 1 cm shortening.
3. Not comminuted.

C/I:

1. Displacement.
2. Open fracture.
3. Compartment syndrome.
4. Floating knee.

Close reduction and cast immobilization:

1. **Above knee back slab and U-shape slab if surgical treatment is chosen** لأن الكسر مب أوين بالتالي ماهو اميرجنسي لكن بنفس الوقت ما أقدر أخلي المريض بدون شيء الين وقت السير جري فيحط له شيء يثبت له الكسر الين يروح للأو آر
2. Above knee full cast if non-surgical treatment is chosen: it must be bi-valved to minimized compartment syndrome.
 - Always provide patient with Compartment Syndrome checklist if patient is discharged home with cast.
 - NWB for 8 weeks with cast immobilization.

Surgical treatment:

1. **Most common modality of treatment.**
2. **Most commonly IM nail fixation.** Sometimes plates and screws



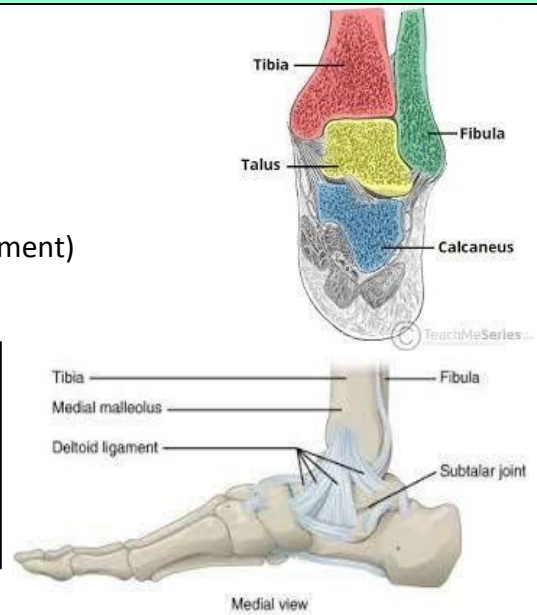
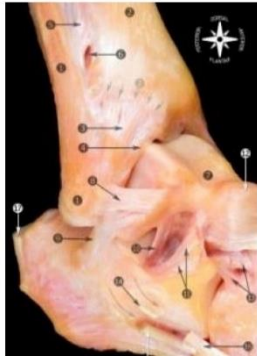
★ Complications

- **Non-union: most common complication**
- Delayed union
- Infection: open fracture
- DVT/PE

4. Ankle Fracture⁹ (Low energy (torsional): malleoli fracture)

★ Anatomy

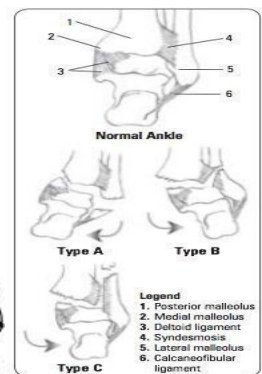
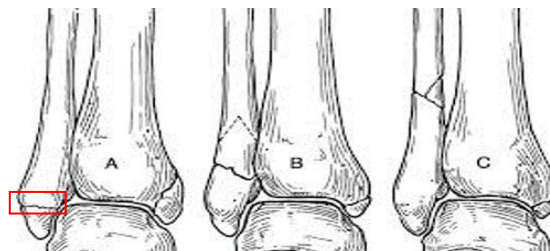
- Medial and lateral malleoli, distal tibia and talus.
- Highly congruent joint (stable)
- Fibula is held to distal tibia by syndesmosis ligament.
- **Medial malleolus is held to talus by deltoid ligament.**
- Lateral malleolus is held to talus by LCLI (lateral collateral ligament)



★ General Notes

Classification:

1. Stable v.s. **Unstable fracture: Lateral displacement of talus** (in unstable: medial side is clear joint space becomes wider)
2. Medial, lateral or **bimalleolar** fracture.
3. Lateral malleolus: Weber A (below level of syndesmosis), B (at level of syndesmosis), C (above level of syndesmosis)



★ Clinical Findings

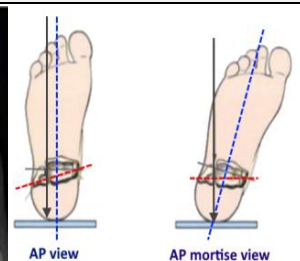
- Look for Fracture symptoms and signs.
- Assess medial joint ecchymosis or tenderness to assess medial malleolus and deltoid ligament integrity.
- Assess N/V status (before and after reduction).
- **Valgus deformity in medial malleolus fracture.**



★ Imaging

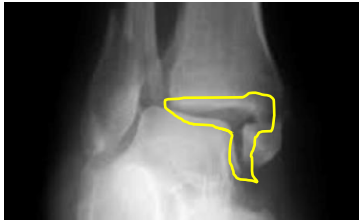
X-Ray:

1. AP
2. Lateral
3. Mortise view 50° anterior rotation. (special view)
4. Long leg x-rays: if only medial malleolus is broken.

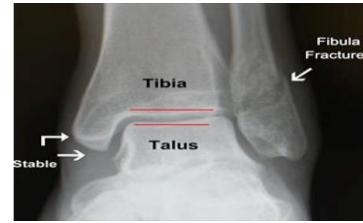


CT SCAN IF FRACTURE EXTENDS TO ARTICULAR DISTAL TIBIA SURFACE.

Unstable: > 4mm lateral translation clear space



Stable: okay space treated with cast



★ Treatment

Intact medial malleolus:

Weber A: No surgery

1. Splint + NWB X 6 weeks.
2. Early ROM.

Weber B/C: Plate +/- syndesmotic screw

1. If medial joint line widen (unstable): ORIF, if the tibia and fibula are displaced I will put the syndesmotic screw between them, it is called **syndesmotic screw** because it acts as a syndesmotic ligament (hold the bones together until syndesmosis heal).
2. If not: Call Orthopedic for stress film x-rays to see if it's open or not

If both malleoli are broken: ORIF (ORIF both bones +/- syndesmotic screw)

When do we have to put the syndesmotic screw? if there is lateral translation of the talus intraoperative → if the talus is still moving with stress after fixation → syndesmosis is open, and we put screws. so, after fixation in weber B or C/ bimalleolar fracture, we do stress test and accordingly we put syndesmotic screws or not.

